1884MNRAS..44..366C

Note on a Method of Reducing the Friction of the Polar Axis of a Large Telescope. By A. A. Common.

In large telescopes the friction of the polar axis is generally reduced by means of wheels placed so as to take from off the upper and lower bearings the greater part of the total weight. The points or lines of contact between those wheels and the axis are very small, and the least inequality in shape or in the hardness of the metal must produce for slow motions an extremely irregular action.

The plan of floating off some of this weight, and so reducing the friction, has been employed by me in the construction of an 18-inch and a 3-foot Reflector, but in both cases only in a partial manner.

In the account I gave (in vol. xlvi. of the *Memoirs* of this Society) of the mounting of this latter telescope, I mentioned that this principle could be applied in a very complete manner by so arranging matters that the centre of gravity of the moving parts should be over the centre of flotation.

I had then considered several ways of doing this. Two of these I now propose to mention more particularly, and I have little hesitation in doing so, as the working of the 3-foot telescope has been so good in this respect as to make me think that the complete application of this principle would be the best way we could have of ensuring the proper and equable motion of the telescope in time. The first plan, arranged for the 3-foot, mounted on what is known as the German form of mounting, is simple. It is to enlarge the diameter of the polar axis at the upper part by a drum or cylinder of cast iron, of such a diameter and depth as to get the requisite displacement of mercury contained in an outer cylinder surrounding the drum spoken of. Altering the figures to suit an object-glass of, say, 40 inches aperture and of about 60 feet focal length (as the largest that may be at present thought of), we should have as the weight brought down to the centre of the declination axis something like six tons. This could be dealt with effectively by making the drum on the polar axis about 6 feet diameter and 3 feet deep, something less than one-half of this being immersed. These figures are, of course, merely approximate, but if the size and weight of the object-glass be known, the rest can all be easily calculated.

Here, from the low position of the centre of gravity of the whole and its proximity to the upper bearing of the polar axis, it is possible to get the centre of gravity and the centre of flotation in a vertical line in the way indicated.

This plan was not used: the form of mounting determined on as regards that part above the polar axis required that the centre of gravity of this part should be some distance from the upper bearing; the following arrangement was then planned to meet this requirement, but it also was not used, as it involves

1884MNRAS..44..366C

greater bulk than that finally adopted, and is only applicable to a permanent position.

In this the liquid proposed to be used is water or oil, the polar axis being made very much larger to get the necessary displacement, not only to carry itself and the weight of the telescope, but also to carry such a weight at the lower part as would bring the centre of gravity of the whole in such a position to the centre of flotation of the immersed part as to cause the axis to float at the required angle. For example, if we take the case of an 8-foot mirror, with a mounting for the upper part the same as my 3-foot telescope, we should have about nine tons, to be supported at a distance of about 8 feet from the upper bearing. If we now make a polar axis of boiler-plate about 50 feet long and 8 feet mean diameter, cylindrical, or preferably conical, and immerse this in water, we should be able by adding weight at the lower part to get such an arrangement that if the whole were placed in water it would float at the angle required, with the upper bearing above the water; it would then be only necessary to provide proper bearings for top and bottom, and add sufficient weight to ensure contact of the axis, and moor it, as it were, in its proper place, to complete an arrangement that would be, in my opinion, the best possible for the purpose. The weight we have taken as concentrated at the point 8 feet above the upper bearing can, of course, represent any form of optical arrangement that it is required to carry round, as, for instance, an Equatorial coudé; in this case the application would be easy, as the weights could be placed lower, and a continuation of the polar axis, of a similar but lighter construction, would form the tube and dispense with the upper bearing and pier otherwise needed. Or an arrangement for the use of a concave mirror, fixed at right angles to the polar axis at a distance something less than its focal length, with a plane mirror opposite to it similar in proportionate size, angle, position, and arrangement for turning, to the first mirror of the Equatorial coudé, the light of an object reflected from this plane mirror on to the concave mirror would be sent by this to a plane mirror placed, as in the Newtonian telescope, and fixed where the line joining the centres of the plane and concave mirrors, cuts the central line of the polar axis, from which it would pass out in the direction of this latter line, forming an image above, where it could be conveniently viewed or used.

The chief difficulty here would be the large plane mirror, but from what has been recently done, this may not be even a difficulty. If the plane mirrors can be made as easily and as well as the concave ones, such a plan of mounting allows them to be mounted in a very cheap and effective manner, and quite does away with the costly house or covering, and yet keeps all the advantages that other forms give.

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1884MNRAS..44..366C

Note on Dr. N. de Konkoly's Remarks on Mr. Hilger's Illumination of Micrometers with Vacuum Tubes. By Rev. S. J. Perry, F.R.S.

The adverse criticism of Dr. Konkoly appears to arise from a mistake. The micrometer exhibited at the meeting of this Society differs entirely in the method of illumination from the instrument at the Observatory of Kalocsa. The latter was constructed in 1880, and has a side illumination, whereas the curved vacuum tube in the Vizagapatam micrometer is placed inside the micrometer, and gives uniform illumination of the whole system of webs.

The whole of the Equatorial, including micrometer and circles, may be most conveniently illuminated by a couple of bichromate cells, with wires that may be attached as required to fixed vacuum tubes. Such a system of illumination has been in use for some time at one of the private observatories of Lancashire, and is found to answer perfectly. That Dr. de Konkoly can obtain equally satisfactory results with a number of small Swan lamps is a matter of congratulation.

Stonyhurst Observatory:
1884 *May* 7.

The Orbit of Pons' Comet. By J. Morrison, M.A., M.D., Assistant on the American *Ephemeris and Nautical Almanac*, Washington, D.C.

The only orbits of this comet which have been published are those of the late Prof. Encke and of Messrs. Schulhof and Bossert: the former deduced from observations extending over a period of only two months in the year 1812, and the latter from observations made in 1883, and subsequently corrected two or three times by equations of condition. Neither Encke's orbit nor that of Schulhof and Bossert represents the motion of the comet with that degree of accuracy which modern investigations demand. In order to obtain an independent determination of the elements, I select the three following observations made at Washington:—

Washington M.T.	Apparent α	Apparent δ
	° ′ ″	° ′ ″
1883 Oct. 10·307425	248 25 56·1	+56 51 49·0
Dec. 27·249330	317 34 50·4	+29 31 14·8
1884 Jan. 21·299233	357 36 1·5	−13 31 23·1

The comparison stars were respectively, a *Berliner Jahrbuch*